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DESCRIPTION

CODING APPARATUS AND CODING METHOD OF TIME-VARYING IMAGE
RECEIVED
SIGNAL

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Technical Field

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The present invention relates to a coding apparatus and a coding method of digital time-varying image signals for the use of a visual-TV telephone, a TV-video conference, and the like, and more particularly, the present 10 invention relates to a coding apparatus and a coding method of digital time-varying image signals in image communication on transmission lines on which transmission errors occur. are generated. The present invention also 15 relates to a decoding apparatus and a decoding method.

Background Art

As a conventional coding method of digital time-varying image signals, there can be cited the coding 20 method in ITU-T (International Telecommunication Union - Telecommunication Standardization Sector) Recommendation H.261 that was recommended in March, 1993. The featured coding method of H.261 is a motion compensation prediction systemscheme. The motion compensation prediction system 25 scheme is performed as follows.

First, an input image picture and a pre-coded picture are compared, and a motion quantity between them is measured

(motion detection). An input image picture is predicted on the basis of the motion quantity and the pre-coded picture. The difference between the predicted image (prediction image) and the input image picture (prediction error signal) is ~~calculated~~determined, and the prediction error signals and the ~~aforsaid~~ motion quantity are transmitted to a reception side. Thereby, image information can be transmitted in a small data quantity.

Moreover, in H.261, there is another method different from the motion compensation picture prediction ~~systemscheme~~. The method does not use the difference between the prediction image and the input image picture, but the method codes the input image picture itself. The method is called as "intra-coding mode decoding scheme". The intra-coding mode decoding scheme is used ~~in a case where~~ ~~any no~~ pre-coded pictures exist such as the beginning of communication although the generated data quantity is larger than that in the motion compensation prediction ~~systemscheme~~, and ~~in a case where~~ the correlation between an input image picture and a pre-coded picture is low and the data quantity is larger than that in the motion compensation prediction ~~systemscheme~~.

Moreover, ~~in the case where when~~ an transmission error ~~is generated~~occurs on the transmission lines and a section of images is deteriorated, because the deterioration of the picture quality is propagated to the next picture in turn in the motion compensation prediction ~~system~~scheme.

in which only the prediction error signal is transmitted, the deterioration of the picture quality can be recovered by using the adoption of the intra-coding.

Both the motion compensation prediction scheme and the intra-coding scheme divide a picture into blocks (coded blocks), each having 16×16 pixels, and in both of the motion compensation prediction system and the intra-coding mode, and both the systems are applied at every on a per coded block basis. A picture in which all of the coded blocks in it are forcedly intra-coded is called an as "intra-picture", and a picture coded in conformity with the motion compensation prediction system scheme is called an as "inter-picture".

On the other hand, there is a concealing concealment processing technique as a technique for suppressing the deterioration of the picture quality when a transmission error occurs during transmission. The concealing concealment processing technique is the processing to do voluntarily on the side of the reception, and is not included in the contents which are prescribed by of the recommendation. However, by performing the processing, the picture quality deterioration in case of the occurrence of the transmission error can be suppressed. As one of the concealing concealment processing techniques, there is a method in which when a transmission error occurred and received coded block data can not be decoded correctly, coded block data existing at the same position in the

pre-coded picture is output as it is.

Moreover, as one of the ~~concealingconcealment~~
~~processing~~ techniques, there is a method in which a motion
quantity of a coded block that could correctly be decoded
5 and exists at a peripheral position is adopted as the motion
quality of the present coded block and a prediction image
is generated from a pre-coded picture by the use of the
adopted motion quantity and the generated prediction image
is output.

10 When image communication begins, generally, an
intra-picture is used as the first picture. This is
because a pre-coded picture that becomes always necessary
in case of motion compensation prediction coding does not
exist at this time.

15 When a transmission error occurs during the
transmission of the first picture, a coding block of a
section of the first picture ~~becomes impossible to~~
be decoded correctly. In this case, because ~~any no~~
pre-coded picture ~~does not exists~~, it is impossible to
20 do the ~~concealingconcealment~~ processing using a section
of the pre-coded picture. Accordingly, the
~~concealingconcealment~~ processing of the section of the
first picture ~~must be~~ ~~cannot help~~ ~~performed~~ by a ~~means~~
~~of a beforehand~~ prescribed value.

25 As described above, ~~when a transmission error occurs~~
~~in the first picture, the picture quality when a~~
~~transmission error occurred in the first picture~~

deteriorates more remarkablyseverely than the picture quality when concealingconcealment processing is performed ~~in the case where~~when a pre-coded picture exists. Moreover, because the motion compensation prediction system scheme is used, there is a problem that the deterioration of the picture quality in the first picture is propagated in the second and following pictures wand pictures after it with the elapse of time.

10 Disclosure of Invention

An object of the present invention is to provide a coding apparatus and a coding method of a time-varying image signal, ~~both capable of suppressing~~that suppress ~~severe~~the remarkable picture quality deterioration at ~~the~~ time of the beginning of communication.

A subject matter of the present invention is that a plurality of pictures are continuously (N times) coded in conformity with the intra-coding~~decoding~~medecoding scheme (N times) from the beginning of communication, and that the first $(N - 1)$ pictures are transmitted in a rough coarse picture quality and the last Nth picture is transmitted in a fine picture quality.

Brief Description of Drawings

FIG. 1 is a block diagram showing the configuration of a radio communication apparatus equipped with a coding apparatus according to an embodiment of the present

invention;

FIG. 2 is a block diagram showing the configuration of the coding apparatus according to the embodiment of the present invention;

5 FIG. 3 is a block diagram showing the configuration of a decoding apparatus corresponding to the coding apparatus according to the embodiment of the present invention; and

FIG. 4 is a frame configuration diagram of a signal
10 to be used in the radio communication apparatus equipped with the coding apparatus of the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, embodiments of the present invention
15 will be described in detail by reference to the attached drawings.

(EMBODIMENT 1)

FIG. 1 is a block diagram showing the configuration of a radio communication apparatus equipped with a coding apparatus according to embodiment 1 of the present invention. Here, the "radio communication apparatus" means a communication terminal apparatus and the like such as a base station apparatus and a mobile station in a digital radio communication system. Moreover, the radio communication apparatus may be a portable terminal and may be configured in a form to be used in a state of being connected with a computer.

In the radio communication apparatus, an image is taken in by an imaging section 101 such as a camera on the transmission side, and is output to an A/D transformer 102 as an image signal. In the A/D transformer 102, the 5 image signal is transformed to a digital sound signal, and is output to a coding section 103. The coding section 103 performs the image-coding processing of the digital sound signal, and outputs coded information to a modulation/demodulation section 104. The 10 modulation/demodulation section 104 digitally modulates the coded image signal, and transmits the digitally modulated image signal to a radio transmission circuit 105. The radio transmission circuit 105 performs the prescribed radio transmission processing of the modulated 15 signal. The processed signal is transmitted through an antenna 106. Incidentally, a processor 107 performs its processing by using the data stored in a RAM 109 and a ROM 108 appropriately.

On the other hand, on the reception side of the radio 20 communication apparatus, the prescribed radio reception processing of a signal received by the antenna 106 is performed by a radio reception circuit 110, and the processed signal is transmitted to the modulation/demodulation section 104. The 25 modulation/demodulation section 104 performs the demodulation processing of the received signal, and outputs the demodulated signal to the decoding section 111. The

decoding section 111 performs the decoding processing of the demodulated signal to obtain a digital decoded signal, and outputs the digital decoded signal to a D/A transformer 112. The D/A transformer 112 transforms the digital 5 decoded signal output from the decoding section 111 to an analog decoded signal, and outputs the analog decoded signal to a display section 113 such as a display. Finally, the display section 113 displays the image.

Here, the coding section 103 and the decoding section 10 111 ~~is~~are operated by the processor 107 such as a digital | signal processor (DSP) by the use of memories stored in the RAM 109 and the ROM 108. Moreover, the programs for these operations are stored in the ROM 108.

FIG. 2 is a block diagram showing the configuration 15 of the coding apparatus of the present invention which is applied to the coding section in the radio communication apparatus shown in FIG. 1.

In FIG. 2, a raster/coded block transformation section 201 transforms obtained image data to a 20 raster/coded block. The position information of the raster/coded block transformed by the raster/coded block transformation section 201 is transmitted to a multiplexing section 216. Moreover, the data of the raster/coded block 25 (the present picture) is transmitted to a motion detection section 202.

The motion detection section 202 detects the motion of the image on the basis of the difference between a

previous picture and the present picture. In this case, the previous picture is output from a frame memory 203. memory controlling section 204 controls the output of the reproduced image memorized in the frame memory 203 on the 5 basis of the motion quantity information from the motion detection section 202. Incidentally, the motion quantity information is transmitted to a variable length coding section 215, and is transformed to a Huffman code there ~~to be and~~ transmitted to the multiplexing section 216.

10 A picture counter 205 counts the number of pictures. The counted value ~~of on~~ the picture counter 205 is transmitted to a coding controlling section 206. The coding controlling section 206 ~~judgets determines on one of whether the coding method of input time varying image~~ 15 signal is the intra-coding mode decoding mode under the motion compensation prediction system mode, and then the coding controlling section 206 outputs the ~~determined judged~~ ~~coding mode decoding mode~~ to a switch 207. And the coding controlling section 206 controls a quantization parameter in conformity with the ~~coding mode decoding mode~~. This 20 quantization parameter is transmitted to a quantization section 210. Incidentally, the ~~coding mode decoding mode~~ information is transmitted to the multiplexing section 216.

25 In the motion compensation prediction scheme mode, ~~The~~ coded block data is compared with the previous picture stored in the frame memory 203 by a subtracter 208, ~~an~~

~~ease of the motion compensation prediction system mode,~~
and the difference is transmitted to a discrete cosine
transformation section (DCT) 209. Incidentally, in case
~~of the intra-encoding mode~~
5 of the ~~intra-encoding mode~~
is transmitted to the discrete cosine transformation
section 209.

The data that has received the discrete cosine
transformation is transmitted to quantization section 210,
and is quantized on the basis of the quantization parameter
10 transmitted from the coding controlling section 206. The
quantized data of the DCT coefficient is transmitted to
a variable length coding section 211, and is transmitted
to an inverse quantization section 212. The variable
length coding section 211 transforms the quantized data
15 of the DCT coefficient into a Huffman code, and transmits
the Huffman code to the multiplexing section 216.

The quantized data of the DCT coefficient transmitted
to the inverse quantization section 212 is inversely
quantized and becomes a DCT coefficient ~~to be and~~
20 transmitted to an inverse discrete cosine transformation
section 213. The inverse discrete cosine transformation
section 213 performs the inverse discrete cosine
transformation by the use of the DCT coefficient ~~to and~~
obtains coded block data corresponding to the difference
25 between the previous picture and the current picture.

An adder 214 obtains the present picture by adding
the coded block data and the previous picture, that is,

by updating the previous picture in its moved parts. The obtained present picture is transmitted to the frame memory 203 and is stored therein.

The multiplexing section 216 multiplexes the DCT coefficient, the motion quantity information, the position information of the coded block, and the ~~coded coding mode,~~ and ~~to obtains~~ multiplexed data. The multiplexed data is transmitted.

Next, the operations of the coding apparatus having the ~~aforesaid above~~ configuration will be described.

An input image is divided into coded blocks in a size of, for example, 16×16 pixels in the raster/coded block transformation section 201 ~~to be and~~ output therefrom. Next, the divided coded block data is transmitted to the motion detection section 202, and is compared with a previous picture in the frame memory 203 therein. Then, the motion quantity of the present coded block (the difference between the previous picture and the present picture) is obtained. The motion quantity information is transmitted to the variable length coding section 215, and is transformed to a Huffman code therein ~~to be and~~ transmitted to the multiplexing section 216.

The picture counter 205 counts and outputs the number of pictures ~~which were~~ input from the beginning of communication. ~~beginning time~~. The information of the image ~~which was beforehand selected beforehand~~ (the coding image choice information) by a (not shown) processing

section for selecting an image to be coded is input into the picture counter 205. The picture counter 205 increases its counting value ~~at upon every image information inputting of the image information.~~ Moreover, the picture 5 counter 205 is configured so that the picture counter 205 is automatically reset when the power source of the apparatus is turned on or ~~at the initial time of in an early stage in~~ image transmission.

The switch 207 switches the output of the picture 10 from the frame memory 203 on the basis of the information of the ~~coding medecoding scheme~~ of the coding controlling section 206. To put it concretely, in case of the ~~intra-coding medecoding scheme~~, the switch 207 is switched to the side of "0". And, in case of the motion compensation 15 prediction ~~systemscheme~~, the switch 207 is switched to the frame memory 203 to make the frame memory 203 output the date of the previous picture to the subtracter 208.

The subtracter 208 obtains the difference between the previous picture and the present coded block data to 20 output the obtained difference value to the discrete cosine transformation section 209. In the discrete cosine transformation section 209, the difference value is changed into a frequency domain, ~~and it becomes a DCT coefficient, and is to be transmitted to the quantization section 210.~~ 25 In the quantization section 210, the DCT coefficient is quantized ~~and to be transmitted to the variable length coding section 211 as a quantized data.~~ In the variable

length coding section 211, the quantized data is transformed to a Huffman code. Incidentally, in case of the ~~intra-coding mode~~coding scheme, the difference value becomes the coded block data as it is, and, in case of 5 the motion compensation prediction ~~systems~~scheme, the difference value becomes a motion prediction error signal.

In the inverse quantization section 212 and in the inverse discrete cosine transformation section 213, the DCT coefficient of the quantized frequency domain is 10 restructured to the original difference value, ~~in the inverse quantization section 212 and in the inverse discrete cosine transformation section 213, and the restructured difference value is added to the previous picture from the frame memory 203, and is written in the frame memory 203 for the use of the coding the next picture.~~

The coding block data transformed to the Huffman code, the DCT coefficient, the motion quantity information, the coded block position information and the ~~coding mode~~encoding scheme are multiplexed to be one data in the multiplexing 20 section 216 ~~to be~~and output. For example, in a multiplex data, as shown in FIG. 4, the coded block position information 402 is arranged between a start code 401 and a header 403, and ~~coding mode~~encoding scheme information 404, motion quantity information 405 and a coefficient 25 of the cosine transformation 406 are arranged following the header 403.

The coding apparatus of the present invention surely

transmits the first image, which is used as a reference image, by transmitting the same image at a plurality of times at the beginning of communication or in an early stage in the initial time of the transmission of an image 5 communication by the use of the aforesaid above-mentioned picture counter. Thereby, the processing of the following steps, i.e. the processing of updating the reference image by the difference from the reference image, is made ~~to~~ ~~be~~-sure. As a result, it is possible to ~~make~~ reduce the 10 deterioration of picture quality ~~degradation~~ on the image reception side ~~reduce~~.

Next, a transmission control by the picture counter will be described.

The coding controlling section 206 outputs 15 quantization mode information for controlling the coding apparatus of the present invention to perform the intra-coding to the quantization section 210 when the counted value from the picture counter 205 is equal to or less than a predetermined value (N). In this case, 20 because the switch 207 is switched to the "0" side in conformity with an instruction from the coding controlling section 206, the quantization section 210 performs the quantization of the DCT coefficient about the intra-picture.

25 Moreover, when the counted value ~~of~~ on the picture counter 205 is larger than N, the coding controlling section 206 outputs the ~~coding mode~~ encoding scheme information for

controlling the coding apparatus to perform the coding in conformity with the motion compensation prediction system scheme to the quantization section 210. In this case, because the switch 207 is switched to the frame memory 5 203 side in conformity with the instruction from the coding controlling section 206, the quantization section 210 performs the quantization of a DCT coefficient about an inter-picture.

Moreover, the coding controlling section 206 outputs 10 to the quantization section 210 a signal for controlling the coding apparatus so that to make the value of quantization parameter is large, that is, to make namely the image is rough coarse, when the counted value is equal to or less than $(N - 1)$, and that to make the value of 15 the quantization parameter is small, that is, to make namely the image is fine, when the counted value is N .

For example, in case of when N is three, that is, when namely in the case where the number of times of the plural transmission is three, examples of the coding 20 medecoding scheme and the quantization parameter in each picture are shown in the following.

1st picture: Intra-coding medecoding scheme,

Quantization parameter = 31

25 2nd picture: Intra-coding medecoding scheme,

Quantization parameter = 31

3rd picture: Intra-coding medecoding scheme,

Quantization parameter = 8

4th picture and the following: Motion compensation prediction system—scheme quantization, Parameter is arbitrary.

5 (Smaller quantization parameters indicate finer images.)

The picture quality and the number of times of transmission of the image which are transmitted at a plurality of times can be determined under the consideration based on the certainty of the transmission thereof and the data quantity thereof. In consideration of these points, it is preferable that the number of times of transmission is three and only the final image is made 15 ~~to be fine~~.

When the difficulty of the occurrence of errors in the case where the number of times of transmission is three is calculated determined, the result becomes as follows. As the preconditions, the following conditions are 20 supposed.

Transmission error rate: 1e-4 (Error of one bit occurs at every per 10,000 bits on an average),

Code quantity of a fine picture quality: 16,000 bits,

Code quantity of a ~~rough~~coarse picture quality: 6,400

25 bits.

When the first and the second pictures are coded

~~roughcoarsely~~ and the third picture is coded finely, the code quantity of each picture becomes ~~the followingas~~ follows.

- Code quantity of the first picture: 6,400 bits,
5 Code quantity of the second picture: 6,400 bits,
 Code quantity of the third picture: 16,000 bits.

In this case, if the transmission error rate is $1e-4$,
the probability of the occurrence of a transmission error
10 in the first picture is $6,400 \text{ bits} \times 1e-4 = 0.64$. Moreover,
if the number of the transmission units (the unit of the
transmission ~~in the case where~~ where a screen is divided
into narrow strips) is nine, the probability that an error
~~is generatedoccurs~~ in any one of the nine transmission
15 units is $6,400 \text{ bits} \times 1e-4 \times 1/9 = 0.07$ when nine transmission
units have the same probability that an error ~~is~~
~~generatedoccurs~~ in each unit.

Similarly, as for the second picture, too, the
probability is $6,400 \text{ bits} \times 1e-4 \times 1/9 = 0.07$. As for the
20 third picture, because the code quantity thereof is 16,000
bits, the probability is $16,000 \text{ bits} \times 1e-4 \times 1/9 = 0.18$.

The probability that errors ~~are generatedoccur~~ in
the same transmission unit among the nine transmission
units at all of three times of transmission is
25 $0.07 \times 0.07 \times 0.18 = 0.008$.

Because, in the conventional coding apparatus, only
the first picture is the picture in conformity with the

intra-~~coding mode~~ decoding scheme and the second and following pictures are pictures in conformity with the motion compensation prediction system scheme, the probability that the reference image becomes impossible to be used (the probability that a coded block cannot be decoded owing to a transmission error) is 0.18. Therefore, the embodiment of the present invention can decrease the probability that it becomes impossible to use the reference image is reduced by about 95 % in comparison to the conventional coding apparatus.

Incidentally, as for the code quantity, the ratio of the intra-~~coding mode~~ decoding scheme (Ia) code quantity (fine), the intra-~~coding mode~~ decoding scheme (Ib) code quantity (~~coarse~~), and the motion compensation prediction scheme system (P) code quantity is about 7 : 3 : 1, the code quantities from the beginning of communication through the fourth picture in comparison with the prior art are as follows the following in comparison with the prior art:

I P P P = 7, 1, 1, 1 = 9 (in the prior art),
Ib Ib Ia P = 3, 3, 7, 1 = 14 (in the present invention).

Then, the increased quantity of the present invention shows a 1.5 times increase is one and a half times.

Under the consideration of the increased code quantity and the probability that the first picture becomes impossible to be used like that, the number of times of transmission and the picture quality and so on can be

determined. Because the generated code quantity depends on input images, these number of times of transmission and the picture quality are appropriately changed.

In the coding apparatus of the present invention,
5 a plurality of pictures are coded in conformity with the ~~intra-encoding mode~~ ~~encoding scheme successively in succession~~ (N times) from the beginning of communication, and first (N - 1) pictures are transmitted in ~~rough~~ ~~coarse~~ picture ~~qualities~~ ~~quality~~, and further the last Nth picture is
10 transmitted in a fine picture quality.

According to the present invention, the probability of never correctly decoding ~~that~~ a coded block at the same position ~~n~~ becomes impossible to be correctly decoded even once ~~is~~ ~~can~~ be decreased, and the propagation of the deterioration of picture quality is prevented, by transmitting an intra-picture (N-1) times ~~in~~ ~~successions~~ ~~successively~~. Consequently, if there is a coded block that ~~can~~ ~~not~~ be correctly be-decoded owing to the occurrence of a transmission error in the first picture, because the next picture is intra-coded and transmitted ~~in a state of being coded in conformity with the intra-encoding~~, so that, in the next picture, the deterioration in the picture quality of that portion can be recovered unless it becomes possible to recover the 25 coded block from being deteriorated in its picture quality unless the coded block at the same position in the next picture ~~cannot~~ ~~be~~ correctly be decoded owing to a

transmission error.

In this case, because the intra-picture has a code quantity larger than that of the inter-picture in conformity with the motion compensation prediction coding system scheme, the coding apparatus of the embodiment takes a lot of time necessary for the transmission from the side of transmission to the side of reception. Accordingly the coding apparatus suppresses the code quantity by transmitting the first $(N-1)$ pictures in a ~~rough~~coarse picture quality for shortening the transmission time. Moreover, ~~it becomes possible to decrease the probability that a transmission error occurs is generated in the $(N - 1)$ pictures~~ decreases by making the picture ~~qualities~~quality of the $(N - 1)$ pictures ~~rough~~coarse to decrease the code quantity.

(EMBODIMENT 2)

FIG. 3 is a block diagram showing the configuration of a decoding apparatus corresponding to the coding apparatus according to the embodiment 1.

In FIG. 3, a received signal is transmitted to a separation section 301 ~~to be and~~ separated there to a Huffman code of a DCT coefficient, a Huffman code of motion quantity information, coded block position information, and ~~coding~~ decoding scheme information. The separated codes and information are transmitted to respective processing sections. To put it concretely, the DCT coefficient is

transmitted to a variable length decoding section 302; the motion quantity information is transmitted to a variable length decoding section 305; the coded block position information is transmitted to a frame memory 307
5 and a decoding error memory 310; and the ~~encoding mode~~decoding scheme information is transmitted to an ~~intra-transmission requirement~~intra-transmission request judging section 309.

The DCT coefficient ~~that was~~ coded by the variable length decoding section 302 is transmitted to an inverse quantization section 303 ~~to be~~and quantized inversely. The DCT coefficient ~~which was~~ quantized inversely is transmitted to an inverse discrete cosine transformation section 304, and is used for the inverse discrete cosine 15 transformation there.

The motion quantity information ~~that was~~ decoded by the variable length decoding section 305 is transmitted to a memory controlling section 306. The memory controlling section 306 controls a picture output from 20 the frame memory 307. Incidentally, when a decoding error ~~is generated~~occurs in the variable length decoding sections 302, 305, a decoding error signal is transmitted to the decoding error memory 310.

The intra-transmission requirement judging section 25 309 judges whether or not an ~~intra-transmission requirement~~intra-transmission request is necessary or not based on whether or not the picture in which the decoding

error occurred is an intra-picture, on the basis of whether
the picture in which a decoding error was generated is
an intra-picture or not, namely; that is, based on whether
or not a coded block exists that was not correctly decoded
5 even once in conformity with the intra-encoding mode
decoding scheme exists or not, and transmits an intra-transmission
requirement intra-transmission request signal to a
communication companion.

In the decoding apparatus, the position of a coded
10 block that could not be correctly decoded owing to a
transmission error among intra-pictures received from the
beginning of communication is memorized in the memory.
In the case whereWhen a coded block that could not be
correctly decoded in conformity with the intra-encoding
15 modedecoding scheme when an inter-picture is first received
from the beginning of the communication, the decoding
apparatus is controlled to output an intra-picture
transmission requirement to the transmission side. To put
it concretely, the decoding apparatus judgeschecks whether
20 or not a coded block that could not be decoded correctly
exists or not by referring to the memory at the time
of detecting an inter-picture first, and judges whether
the decoding apparatus outputs an intra-picture
transmission requirementrequest to the transmission side.

25 This is due to the following reason. That is, in the
case wherewhen the coded block exists that could not be
correctly decoded in conformity with the intra-encoding

~~medecoding scheme~~ even once at the time of the reception of an inter-picture, no image data is written in the coding block. Consequently, the picture quality of the coded block is ~~remarkably~~ ~~severely~~ deteriorated. When the 5 inter-picture is received in spite of the existence of such a coded block, the deterioration of the picture quality is propagated and unseemly images are kept ~~on~~ being output.

Accordingly, the position of a coded block that could not be correctly decoded from the beginning of 10 communication in conformity with the intra-~~coding~~ ~~medecoding scheme~~ even once is stored. And if the coded block exists that could not correctly be decoded in conformity with the inter-~~coding~~ ~~medecoding scheme~~ even once ~~exists~~ when the first inter-picture is received after 15 the beginning of the communication, the decoding apparatus does not decode the inter-picture, and ~~request~~s ~~sixes~~ an intra-picture ~~from~~ the transmission side. Thereby, an intra-picture having no coded block that could not correctly be decoded in conformity with the intra-~~coding~~ 20 ~~medecoding scheme~~ can be obtained, and then the reference to the coded block that could not be decoded in conformity with the intra-~~coding~~ ~~medecoding scheme~~ even once by the inter-picture is obviated. Thereby, the ~~timewise~~ propagation of the ~~remarkable~~ ~~severe~~ deterioration of 25 picture quality can be avoided.

Next, the operations of the decoding apparatus having the ~~afersaid~~ above configuration will be described.

First, the data transmitted from the transmission side is separated to a Huffman code of a DCT coefficient, a Huffman code of motion quantity information, coded block position information and a ~~coding-mdecoding scheme~~ |
5 information by the separation section 301.

The Huffman code of the DCT coefficient is decoded to a DCT coefficient after quantization by the variable length decoding section 302, and is inversely quantized to the DCT coefficient by the inverse quantization section 10 303. The DCT coefficient which was inversely quantized is transmitted to the inverse discrete cosine transformation section 304, and is used for the inverse discrete cosine transformation there, and then an image data is obtained.

15 The Huffman code of the motion quantity information, too, is similarly decoded to the motion quantity information by the variable length decoding section 305, and is transmitted to the memory controlling section 306. The memory controlling section 306 ~~calculates~~ determines |
20 an address for reading image data from the frame memory 307 on the basis of the motion quantity information.

An output of the frame memory 307 and image data after the inverse discrete cosine transformation are added ~~to~~ |
25 ~~each other~~ by the adder 308, and a reproduced image is reproduced. The reproduced image is output and memorized in the frame memory 307 ~~to be~~ and used for the decoding of the next picture. |

The variable length decoding sections 302, 305 severally output a decoding error signal when they detect a code that does not exist as a variable length code owing to a transmission error during decoding. The decoding 5 error memory 310 memorizes the coded block that could not correctly be decoded ~~at everyon a per coded block basis.~~

The decoding error memory 310 is initialized at a value ~~which is not neither zero nor~~ one, and the value zero is written in the memory 310 to a coded block that 10 was correctly decoded, and the value of one is written in the memory 310 to a coded block in which a decoding error occurred. To a coded block that was once written as zero, the decoding error memory 310 is controlled so as not to write one in it even if a decoding error ~~is generated occurs~~ in the coded block. That is, when a 15 decoding error ~~occurs is generated~~, the error state of the coded block is read out from the decoding error memory 310. If the error state is zero, the contents of the decoding error memory 310 are not updated. If the error 20 state is the initial value, value one is written in, and if the error state is one, the error state is left as it is.

By such controlling, it becomes possible that a coded block that could correctly be decoded even once in 25 conformity with the intra-coding mode ~~decoding scheme~~ is not memorized in the decoding error memory 310 even if the coded block cannot correctly be decoded after that.

The intra transmission
~~requirement~~ intra-transmission request judging section
309 receives the separated ~~coding mode~~ encoding scheme information, and refers to the decoding error memory 310
5 when the section 309 receives a first inter-picture after the beginning of reception. When the coding scheme is the intra-coding scheme and a coded block exists that could not correctly decoded even once ~~exist~~ in the decoding error memory 310 ~~even if the coding mode is the intra-coding mode~~, the intra-transmission request judging section 309
10 outputs an intra transmission
~~requirement~~ intra-transmission request signal to the transmission side (the side of the communication companion).
15 Incidentally, if a ~~concealing~~ concealment processing function is provided on the decoding side, because a pre-coded picture for performing the ~~concealing~~ concealment processing already exists and the probability that a coded block at the same position cannot
20 be correctly decoded for ~~(N - 1)~~ times in succession ~~successively~~ is very low even if a transmission error occurs ~~is generated~~ at the time of receiving the Nth picture, so that severe picture quality deterioration can be avoided. ~~the avoidance of the remarkable~~
25 deterioration of picture quality becomes possible.

By the execution of such control, an intra-picture that has no coded block that could not be correctly decoded

in conformity with the intra-coding mode ~~decoding scheme~~ even once can be obtained, and the reference to the coded block that could not correctly be decoded in conformity with the intra-coding mode ~~decoding scheme~~ even once by the 5 inter-picture is obviated, and thereby avoiding the ~~time-wise propagation of the remarkable severe~~ deterioration of picture quality ~~can be avoided~~.

The interactive image communication becomes possible by the configuration providing the ~~aforesaid~~ 10 above-mentioned coding apparatus and the decoding apparatus of the present invention and by the use of the configuration on both of the transmission side and the reception side.

Incidentally, although the time-varying image 15 coding/decoding according to the ~~aforesaid~~ above-described embodiments 1, and 2 are described as the time-varying image coding apparatus/the time-varying image decoding apparatus, these time-varying image coding/decoding may be configured as software. For 20 example, the coding apparatus and the decoding apparatus may be configured ~~such that~~ that a program of the time-varying image coding/decoding programs ~~is stored~~ in a ROM and the time varying image coding/decoding are executed in conformity with the program by instructions 25 of CPU. Moreover, the software may be read out from a medium storing the software, and the time-varying image coding/decoding may be executed by a computer. In such

a case, too, the same operations and effects as those in the embodiments 1, 2 are developed.

Although a case using radio transmission lines ~~that is easy to generate an susceptible to errors error during~~ 5 transmission is described, the present invention may also be applied to a case using wire transmission lines. The present invention especially develops its effects in radio image communication terminals.

The coding apparatus of the present invention ~~is has~~ 10 ~~a configured with a~~ section comprising an intra-coding section for performing ~~the intra-coding in which that codes a~~ ~~coding block as it is, the coding block being formed by~~ ~~with a plurality of blocks a time-varying image signal~~ ~~is divided into the division of a time varying image signal,~~ 15 ~~to a plurality of blocks are coded as they are, and a coding~~ controlling section for ~~performing the controlling the~~ ~~ef-coding such that the successive intra-coding is~~ ~~performed for ef-N pictures from are performed from the~~ beginning of communication in succession.

According to the configuration, the probability of 20 never correctly decoding that a coded block at the same position is decreased, and the propagation of the deterioration of picture quality is prevented by transmitting an intra-picture (N-1) times in succession. 25 becomes impossible to be correctly decoded even once can be decreased by the successive transmission of an intra-picture (N-1) times, and the propagation of the

- deterioration of picture quality is obviated.
- Consequently, if there is a coded block that can not be correctly decoded owing to a transmission error in the first picture, the next picture is intra-coded and transmitted, so that, in the next picture, the deterioration in the picture quality of that portion can be recovered unless the coded block at the same position cannot be correctly be decoded owing to a transmission error.
- Consequently, even if a transmission error is generated in the first picture and a coded block that could not correctly be decoded exists, because the next picture is transmitted after the intra coding thereof, it becomes possible to recover the coded block from being deteriorated in its picture quality unless the coded block at the same position in the next picture can correctly be decoded owing to a transmission error.

The coding apparatus of the present invention has a configuration in which the coding controlling section makes the picture qualities of $(N - 1)$ pictures from the beginning of communication relatively ~~rough~~coarse and makes the picture quality of the N^{th} pictures from the beginning of the communication relatively fine.

According to the configuration, a code quantity can be suppressed to be ~~small~~reduced, and transmission time can be shortened. Thereby, the probability of the occurrence of a transmission error in a picture can be

decreased.

A decoding apparatus of the present invention has:
~~has a configuration comprising:~~ a decoding section for
decoding an image-coded data; a memorizing section for
5 memorizing position information of a coded block in a
time-varying image signal, the coded block corresponding
to an image-coded data that could not correctly be decoded
owing to a transmission error, ~~in a case where~~ where the
image-coded data is an image-coded data after performing
10 ~~of~~ intra-coding ~~thereof~~; and a requiring section for
ascertaining whether a coded block that could not correctly
be decoded even once exists in the memorizing section or
not when a first image-coded data after performing ~~of~~ motion
compensation prediction coding ~~thereof~~ from ~~the~~ beginning
15 of communication, and ~~for~~ requiring ~~requesting~~
transmission of a picture after performing ~~of~~ intra-coding
~~thereof~~ when existence of the coded block that, which
has not been decoded correctly~~is~~, is ascertained.

According to the configuration, an intra-picture
20 which does not have the coding block which could not
correctly be decoded in conformity with the intra-coding
~~and decoding scheme~~ even once can be obtained, and the
~~timewise propagation of the remarkable~~ ~~severe~~
deterioration of image quality can be obviated.

25 The decoding apparatus of the present invention has
~~a constitution configuration~~ in which the decoding section
does not perform decoding ~~of~~ the image-coded data after

~~performing of the motion compensation prediction coding thereof in a case wherewhen the coded block that could not correctly be coded even once exists in the memorizing section when the first image-coded data after performing~~

5 ~~ef~~ the motion compensation prediction coding from the beginning of the communication.

According to the configuration, the reference to the coded block which could not correctly be decoded even once in conformity with the ~~intra-coding mode~~ coding scheme by 10 an inter-picture is obviated, and thereby avoiding the ~~timewise~~ propagation of the ~~remarkable~~ severe deterioration of a picture quality ~~can be avoided~~.

A coding method of the present invention ~~has~~ comprises: an intra-coding step of for performing 15 intra-coding that codes a coding block as it is, the coding block being formed with a plurality of blocks a time-varying image signal is divided into, and a coding controlling step of controlling the coding such that the intra-coding is performed for N pictures from the beginning of 20 communication in succession ~~an intra-coding step for performing intra-coding in which coded blocks formed by division of a time varying image signal to a plurality of blocks are coded as they are; and a coding controlling step for performing control of coding so that successive~~ 25 ~~intra-coding of N pictures is performed from a beginning of communication, and for making the picture qualities of (N - 1) pictures from the beginning of the communication~~

relatively ~~rough~~coarse and the picture, and further for making a quality of ~~a~~Nth pictures from the beginning of the communication relatively fine.

According to the method, the probability of never
5 correctly decoding a coded block at the same position is
decreased and the propagation of the deterioration of
picture quality is prevented by transmitting an
intra-picture (N-1) times in succession. ~~the probability~~
~~that a coded block at the same position becomes impossible~~
10 ~~to be correctly decoded even once can be decreased, and~~
~~the propagation of the deterioration of picture quality~~
~~is prevented, by transmitting an intra picture (N-1) times~~
~~successively. Consequently, if there is a coded block that~~
~~can not be correctly decoded owing to the occurrence of~~
15 a transmission error in the first picture, the next picture
is intra-coded and transmitted, so that, in the next picture,
the deterioration in the picture quality of that portion
can be recovered unless the coded block at the same position
cannot be correctly be decoded owing to a transmission
20 error. ~~Consequently, if there is a coded block that could~~
~~not correctly be decoded owing to the occurrence of a~~
~~transmission error in the first picture, because the next~~
~~picture is transmitted in a state of being coded in~~
~~conformity with the intra coding, it becomes possible to~~
25 ~~recover the coded block from being deteriorated in its~~
~~picture quality unless the coded block at the same position~~
~~in the next picture can correctly be decoded owing to a~~

~~transmission error.~~

A decoding method of the present invention ~~comprises has~~: a decoding step for decoding an image-coded data; a memorizing step for memorizing position information 5 of a coded block in a time-varying image signal, the coded block corresponding to an image-coded data that could not correctly be decoded owing to a transmission error, ~~in a case where~~ where the image-coded data is an image-coded data after ~~performing of~~ intra-coding ~~thereof~~; and a 10 requiring step for ascertaining whether a coded block that could not correctly be decoded even once exists or not when a first image-coded data after ~~performing of~~ motion compensation prediction coding ~~thereof~~ from a beginning 15 of communication is received, and ~~for requesting~~ ~~requesting~~ transmission of a picture after ~~performing of~~ intra-coding ~~thereof~~ when existence of the coded block, which has not been decoded correctly, is ascertained.

According to the method, an intra-picture having no coded block that could not correctly be decoded even once 20 in conformity with the ~~intra-encoding~~ ~~and decoding~~ scheme can be obtained, and thereby ~~avoiding~~ ~~the timewise~~ propagation of the ~~remarkable~~ ~~severe~~ deterioration of picture quality ~~can be avoided~~.

In the decoding step, the decoding method of the 25 present invention does not ~~perform decoding of the~~ image-coded data after ~~performing of the~~ motion compensation prediction coding ~~thereof~~ in a case

~~wherewhen~~ the coded block that could not correctly be coded even once exists when the first image-coded data after ~~performing of~~ the motion compensation prediction coding from the beginning of the communication is received.

5 According to the method, the reference to the coded block which could not correctly be decoded even once in conformity with the ~~intra-encoding mode~~ coding scheme by an inter-picture is obviated, and thereby avoiding the ~~timewise~~ propagation of the ~~remarkable~~ severe 10 deterioration of picture quality can be avoided.

As described above, according to the present invention, the probability that a coded block at the same position ~~becomes impossible to~~ cannot be correctly decoded in conformity with the ~~intra-encoding mode~~ coding scheme even 15 once can be suppressed to be low, and the ~~timewise~~ propagation of the ~~remarkable~~ severe deterioration of picture quality is obviated. Consequently, it becomes possible to provide an image easy to see even if image transmission using transmission lines on which 20 transmission errors ~~are generated~~ occur is performed.

Moreover, ~~in the case where~~ when there are coded blocks at the same position that could not correctly be decoded in conformity with the ~~intra-encoding mode~~ coding scheme even once, the present invention does not perform the ~~decode~~ ing 25 ~~of~~ an inter-picture. Consequently, the ~~remarkable~~ severe deterioration of picture quality is avoided and the ~~timewise~~ propagation of the deterioration is obviated.

Thereby an image easy to see can be provided.

This application is based on the Japanese Patent
Application No. HEI 11-213808 filed on July 28, 1999, entire
content of which is expressly incorporated by reference
herein.

Industrial Applicability

The present invention can be applied to an
10 communication terminal apparatus such as a base station
apparatus and a mobile station in a digital radio
communications system.

CLAIMS

1. A coding apparatus of a time-varying image signal, said apparatus comprising:

intra-coding means for performing intra-coding in
5 which coded block formed by division of a time-varying
image signal to a plurality of blocks are coded as they
are; and

coding controlling means for performing control of
coding so that successive intra-coding of N pictures are
10 performed from a beginning of communication.

2. The coding apparatus of a time-varying image signal according to claim 1, wherein said coding controlling means makes picture qualities of $(N - 1)$ pictures from the beginning of communication relatively rough and makes a
15 picture quality of a Nth picture from the beginning of the communication relatively fine.

3. A base station apparatus including a coding apparatus of a time-varying image signal, said coding apparatus comprising:

20 intra-coding means for performing intra-coding in which coded block formed by division of a time-varying image signal to a plurality of blocks are coded as they are; and

coding controlling means for performing control of
25 coding so that successive intra-coding of N pictures are performed from a beginning of communication.

4. A communication terminal apparatus including a

coding apparatus of a time-varying image signal, said
coding apparatus comprising:

intra-coding means for performing intra-coding in
which coded block formed by division of a time-varying
5 image signal to a plurality of blocks are coded as they
are; and

coding controlling means for performing control of
coding so that successive intra-coding of N pictures are
performed from a beginning of communication.

10 5. A decoding apparatus of a time-varying image signal,
said apparatus comprising:

decoding means for decoding an image-coded data;
memorizing means for memorizing position information
of a coded block in a time-varying image signal, the coded
15 block corresponding to an image-coded data that could not
correctly be decoded owing to a transmission error, in
a case where said image-coded data is an image-coded data
after performing of intra-coding thereof; and

requiring means for ascertaining whether a coded
20 block that could not correctly be decoded even once exists
in said memorizing means or not when a first image-coded
data after performing of motion compensation prediction
coding thereof from a beginning of communication is
received, and for requiring transmission of a picture after
25 performing of intra-coding thereof when existence of the
coded block, which has not been decoded correctly, is
ascertained.

6. The decoding apparatus of a time-varying image signal according to claim 5, wherein said decoding means does not perform decoding of the image-coded data after performing of the motion compensation prediction coding 5 thereof in a case where the coded block that could not correctly be coded even once exists in said memorizing means when the first image-coded data after performing of the motion compensation prediction coding from the beginning of the communication is received.

10 7. A base station apparatus including a decoding apparatus of a time-varying image signal, said decoding apparatus comprising:

decoding means for decoding an image-coded data; memorizing means for memorizing position information 15 of a coded block in a time-varying image signal, the coded block corresponding to an image-coded data that could not correctly be decoded owing to a transmission error, in a case where said image-coded data is an image-coded data after performing of intra-coding thereof; and

20 requiring means for ascertaining whether a coded block that could not correctly be decoded even once exists in said memorizing means or not when a first image-coded data after performing of motion compensation prediction coding thereof from a beginning of communication is 25 received, and for requiring transmission of a picture after performing of intra-coding thereof when existence of the coded block, which has not been decoded correctly, is

ascertained.

8. A communication terminal apparatus including a decoding apparatus of a time-varying image signal, said decoding apparatus comprising:

5 decoding means for decoding an image-coded data;
 memorizing means for memorizing position information
 of a coded block in a time-varying image signal, the coded
 block corresponding to an image-coded data that could not
 correctly be decoded owing to a transmission error, in
10 a case where said image-coded data is an image-coded data
 after performing of intra-coding thereof; and
 requiring means for ascertaining whether a coded
 block that could not correctly be decoded even once exists
 in said memorizing means or not when a first image-coded
15 data after performing of motion compensation prediction
 coding thereof from a beginning of communication is
 received, and for requiring transmission of a picture after
 performing of intra-coding thereof when existence of the
 coded block, which has not been decoded correctly, is
20 ascertained.

9. A coding method of a time-varying image signal,
said coding method comprising:

an intra-coding step for performing intra-coding in
which coded blocks formed by division of a time-varying
25 image signal to a plurality of blocks are coded as they
 are; and

a coding controlling step for performing control of

coding so that successive intra-coding of N pictures is performed from a beginning of communication, and for making picture qualities of (N - 1) pictures from the beginning of the communication relatively rough, and further for
5 making a quality of a Nth picture from the beginning of the communication relatively fine.

10. A decoding method of a time-varying image signal, said method comprising:

a decoding step for decoding an image-coded data;
10 a memorizing step for memorizing position information of a coded block in a time-varying image signal, the coded block corresponding to an image-coded data that could not correctly be decoded owing to a transmission error, in a case where said image-coded data is an
15 image-coded data after performing of intra-coding thereof; and

a requiring step for ascertaining whether a coded block that could not correctly be decoded even once exists or not when a first image-coded data after performing of
20 motion compensation prediction coding thereof from a beginning of communication is received, and for requiring transmission of a picture after performing of intra-coding thereof when existence of the coded block, which has not been decoded correctly, is ascertained.

25 11. The decoding method of a time-varying image signal according to claim 10, wherein in said decoding step, decoding of the image-coded data after performing of the

motion compensation prediction coding thereof is not performed in a case where the coded block that could not correctly be coded even once exists when the first image-coded data after performing of the motion
5 compensation prediction coding from the beginning of the communication is received.

ABSTRACT

A picture counter 205 counts and outputs the number of pictures input from the beginning of communication. A coding controlling section 206 outputs ~~coding medecoding~~ 5 scheme information for controlling a coding apparatus to perform intra-coding when a counted value on~~f~~ the picture counter 205 is equal to or less than a predetermined value (N), and outputs ~~coding medecoding~~ scheme information for motion compensation prediction ~~system~~-scheme when the 10 counted value is more than N. Moreover, when the counted value is equal to and less than (N-1), the coding controlling section 206 outputs a signal for controlling a quantization section 210 to make the value of a quantization parameter large to the quantization section 210, and when the counted 15 value is N, the coding controlling section 206 outputs a signal for controlling the quantization section 210 to make the quantization parameter small to the quantization section 210. A switch 207 is switched to "0" in case of the intra-coding and is switched to a frame memory 203 20 in case of the compensation prediction ~~system~~-scheme in conformity with a signal of the coding controlling section 206.